Addled Tangles of Sanguine Language
—an Eclectic Syncretic Syntactic Taxonomy

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Abstract

The title's "intricate confusion of cheerful utterance" refers to tongue twisters, a type of word game present in most languages. Traditionally, they have played roles in securing cultures, embarrassing friends and strangers, and amusing us. They also have practical uses in speech therapy, language training, elocution, and psychology. At first glance, they may appear to be language-specific, but deeper study reveals similarities across many unrelated languages. This article begins an investigation of analyzing patterns, formalizing their structure, and extracting algorithms for generating novel tongue twisters. Extensions and applications include optical and aural illusions, sonic languages, quasiperiodic structures, finger fumblers, earworms, memes, and modern dance. A goal is the specification of a tongue-twister-prone constructed language.

1. Background on tongue twisters

1.1. General characteristics. Tongue twisters (TTs) are a spoken subclass of patterned artifacts (not solely linguistic) that are hard to produce (e.g., speak, gesture, dance, draw) or interpret (read, see, hear, or even think) without error. Sometimes quick production with repetition elicits the error. The usual goal is entertainment, but many of these ornately patterned utterances have ulterior utility. A typical definition of "tongue twister" (from the *New Oxford American Dictionary*): "a sequence of words or sounds, typically of an alliterative kind, that are difficult to pronounce quickly and correctly, as, for example, 'tie twine to three tree twigs'." While true, the example does not prove it, since it is its departures from alliteration that make it difficult to pronounce: the confusion of w/r and t/th. In other words, there is a broken periodic structure. A possibly tongue-in-cheek self-exemplary definition comes from the *Oxford English Dictionary*: "**tongue-twister**, one or that which is said to twist the tongue; *spec.* a sequence of words, often alliterative, difficult to articulate quickly."

TTs play an important and serious role in adult language instruction, speech diagnosis and therapy, and psychophysiological research and evaluation, including gender-difference studies [1]. Although apparently related, confusing and (at least seemingly) confused speech should be distinguished. We do not attempt to bring glossolalia, Tourette verbal tic, infant speech, or schizophrenic tangled angled ramble under this rudely cubic rubric. And thus we do not survey various very serious areas.

Although frequently written, TTs are more often communicated and rehearsed orally. A few of the examples below depend on the printed form for their meaning, but rely on the spoken form for their confusion. Others are complex both ways, especially if their difficulty is mostly word length, such as:

antidisestablishmentarianistically (from childhood),
pneumonoultramicroscopicsilicovolcanokoniosis (OED lexical champ),
honorificabilitudinitatibus (Shakespeare's longest word).
nordöstersjökustartilleriflygspaningssimulatoranläggningsmaterielunderhållsuppföljningssystem-diskussionsinläggsförberedelsearbeten (Swedish, 130 letters),

http://llanfairpwllgwyngyllgogerychwyrndrobwllllantysiliogogogoch.co.uk/ the longest URL, and the longest placename [2].

German seems to hold the title for longest words, with effectively unbounded word length, despite the long words in true agglutinative languages such as Finnish, Turkish, and Cree.

1.2. Historical applications. Perhaps the earliest literary reference[1] to a TT is the use of the word "shibboleth" in Judges 12:4-6. This eponymous class of TTs has had many uses across languages, for entertainment, embarrassment, security, and discrimination; examples are given below. Another historical link is with incantations and charms, the reduplicative *abracadabr*a and *hocus-pocus* serving as examples, as well as the Latin word-square:

SATOR
AREPO
TENET
OPERA
ROTAS

The role of TTs in elocution training (now an ancient art) is described in [3], where we learn that *Peter Piper* was merely the P entry in an antiquarian abecedarian of TTs.

2. Categories of TTs

2.1. Tripper: the standard TT that is supposed to be difficult to produce correctly, even by native speakers, either on one reading or on repetition (usually urged to be rapid). Trippers use a combination of alliteration and rhyme [4], and this is apparent in all languages.[2] They have two or three sequences of sounds, then the same sequences of sounds with some sounds exchanged. For example, *She sells sea shells on a sea shore, so the shells she sells are sure sea shore shells*. The hardest tongue-twister in the English language is supposedly [4]: *The sixth sick sheikh's sixth sheep's sick.* The following is usually classed as a challenging TT, but the author finds no difficulty in saying it; the charm lies in its heavy repetitiveness leavened with lively meter, so it is included here[3]:

If a Hottentot taught a Hottentot tot
To talk ere the tot could totter,
Ought the Hottentot tot
Be taught to say aught, or naught,
Or what ought to be taught her?

If to hoot and to toot a Hottentot tot
Be taught by her Hottentot tutor,
Ought the tutor get hot
If the Hottentot tot
Hoot and toot at her Hottentot tutor?

Here is one from Farsi: *Shab shabi dishab shabi da shahre sham ashub shod. Shishehgar shashido as shashash shisheha shish hesaro sheshsado shast tikke shod.* This one in Arabic gives an immediate visual impression of alliteration and rhyme [6]: ورت وروة وروا وراورها وراها!

2.2. Shibboleth: an utterance including sounds routine for native producers, but difficult for outsiders. Excluded are mere variations—thus a Canadian can pronounce "about" the same as those south of the border, but would rarely choose to. A genuine example [5] from Poland is:

W Szczebrzeszynie chrząszcz brzmi w trzcinie.[4]

This is used as a standard pop quiz for PSL speakers, but it is often held to be difficult even for native speakers. A similar example in Georgian is *baqaqi ts'khalshi qiqinebs*:

ბაყაყი წყალში ყიყინებს.

or even the single words *c'amc'ami* [5] and *gvprckvni*.

Danish offers these shibbolethic trippers: *døde røde rødøjede rådne røgede ørreder og rødgrød med fløde*[6] and the amazing consonant-free *A æ o æ ø i æ å, æ a!* [6]. Even the name of Xhosa is a shibboleth for this Bantu click language.

2.3. Battologism:[7] a boring repetition, although sometimes as a meaningful string of homonyms and homophones. An example of the former is the repetitious speech of toddlers which is endearing to their family and quickly annoying to others. Here is a construction of the latter, with tediousness avoided only in the written form: *syntax, sin tax, sent ax, scent acts, seine tacks, Saint X, Cintex, sint ex, sans ticks, sane techs*. Punctuation can disambiguate the classical: *Thad, while Had had had "had," had had "had had"; "had had" had had hardly a heady effect on the teacher*; there are ways to carry this on to 40 or more "had"s [7]. Also, *Did not Wright write "rite" right? Wright, write "rite" right, right away!* Here is an excess from Classical Mandarin, rendered here in pinyin romanization:

« Shī Shì shí shī shǐ »	*"Lion-Eating Poet in the Stone Den"*
Shíshì shīshì Shī Shì, shì shī, shì shí shí shī.	*In a stone den was poet Shi: he loved to eat lions, decided to eat ten.*
Shì shíshí shì shì shì shī.	*He often went to the market to look for lions.*
Shí shí, shì shí shī shì shì.	*One day at ten o'clock, ten lions just arrived at the market.*
Shì shí, shì Shī Shì shì shì.	*At that time, Shi just arrived at the market too.*
Shì shì shì shí shī, shì shǐ shì, shǐ shì shí shī shìshì.	*Seeing those ten lions, he killed them with arrows.*
Shì shí shì shí shī shī, shì shíshì.	*He brought the corpses of the ten lions to the stone den.*
Shíshì shī, Shì shǐ shì shì shíshì.	*The stone den was damp. He asked his servants to wipe it.*
Shíshì shì, Shì shǐ shì shí shì shí shī.	*After the stone den was wiped, he tried to eat those ten lions.*
Shí shí, shǐ shí shì shí shī, shí shí shí shī shī.	*When he ate, he found those ten lions to be ten stone lion corpses.*
Shì shì shì shì.	*Try to explain this.* [8]

The sentence "buffalo buffalo buffalo buffalo buffalo buffalo buffalo buffalo" is probably the most outrageous example[8] in English, although the difficulty in pronunciation is syntactic, not phonetic.

2.4. Lokilogism (a neologism here, after the coyotish trickster Loki): a TT whose purpose is to lure the speaker into an erroneous variant that is a rude phrase. It is thus often a derivative or "second-order" TT on its own. Here are some examples:

One smart fellow; he felt smart.
Two smart fellows; they felt smart.
Three smart fellows; they all felt smart.

I'm not the fig plucker,
Nor the fig plucker's son,
But I'll pluck figs
Till the fig plucker comes.

Fire truck tires
  fried Tuck's fires.

Mrs. Puggy Wuggy has a square cut punt.
Not a punt cut square,
Just a square cut punt.
It's round in the stern and blunt in the front.
Mrs. Puggy Wuggy has a square cut punt.

2.5. Rhyme-dominant forms: when rhyme takes over from alliteration. These are probably not so difficult to articulate, but they have more inherent madness. Recall the lines from Danny Kaye's *Court Jester*: *The pellet with the poison's in the flagon with the dragon; the vessel with the pestle has the brew that is true.* [9] Here is a new example: *When the doctor found his pocketwatch picked, the fishmonger suggested patting down the ragamuffin who was his latest customer. That is, the merchant urged his surgeon, "Search an urchin with a sturgeon."* Here we could also include some forms of reduplication [10] (a regular phenomenon in many languages from Greek to English) even triplication [11], plus rhyming slangs, and to some extent Boontling, before we fell pell-mell into wishy-washy razzle-dazzle.

2.6. Flexion orbits: focusing on one-position variation. This class is probably the most restricted, because it requires close repetition except for one sound that must move through many available variants, hence exerting considerable lexical and semantic pressure: *"I must amass mostly messy mousse," muses Miss Moss* and *Alice as is asks for axes*. Examples are often seen in TT collections for speech therapists and ESL students; they aid in phoneme production, distinction, and recognition.

3. Some structural patterns discernible in TTs

3.1. Periodicity and breaks. Periodicity works at two levels in TTs: you repeat the entire TT till errors result, and the confusion comes from repeated components interfering during articulation. A merely repeated syllable, such as *babababa* ..., produces no errors, except from fatigue[9]. Instead, it is the interference between distinct, nearly periodic patterns that leads to interruption, at least in many TTs. Even among purely periodic patterns, confusion or other unexpected side effect results when the repeated element does not resolve in some psychophysical sense. The phenomena of earworms (and memes in general), stuttering, and intention tremor come to mind. These all appear to be repeated elements that do not resolve singly. The Hejnal Mariacki played at the Cathedral of Kraków hourly is another example; it ends abruptly without resolution. Another type is the cyclic repeat that appears not to be. Shepard tones, the Risset glissando, the Knowlton paradox, and a passage in the Fantasy and Fugue in G minor for organ, BWV 542, by Bach are examples [12]. In these, the pitch or tempo appears to ascend (in the last, descend) although the physics are cyclics. Deutsch [13] extends them and adds battological illusions. The Penrose triangle sculpture is cubical or helical but appears planar, periodic, twisted, and impossible.

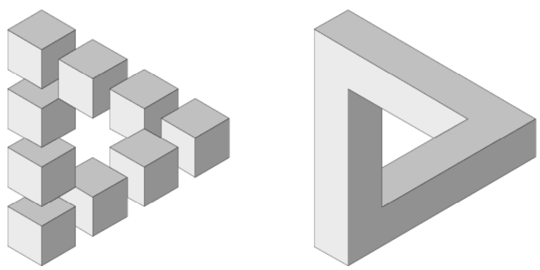

Figure 1. *Two forms of the Penrose triangle* [14]

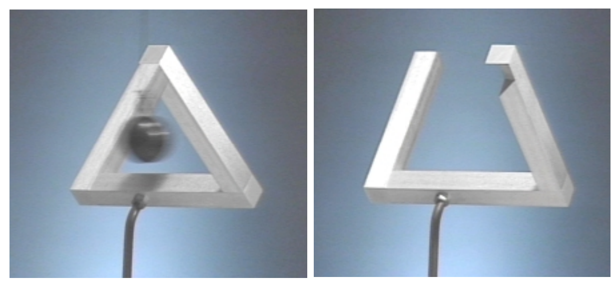

Figure 2. *Impossible triangle sculpture* [15]

3.2. Quasiperiodicity, inescapable variety, and pervasive order. Penrose tiles [16] tessellate the plane, but always nonperiodically, yet the tiling can have 5-fold point symmetry (Fig. 3), which is only one of several ways that a strong form of order creeps back in. Another iterative process produces pinwheel tilings of Radin and Conway (Fig. 4). Danzer and others [17] have found nonperiodic tilings with n-fold point symmetry for any $n \geq 5$ (Fig. 5). These authors have also created similar nonperiodic 3D tilings. The same language is spoken by muqarnas (notably on the ceiling of the Alhambra's Sala de Dos Hermanas[10]).

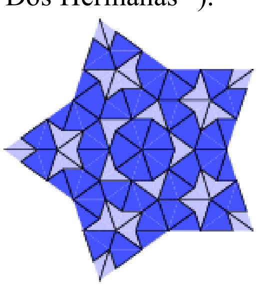

Figure 3. *Penrose* [16]

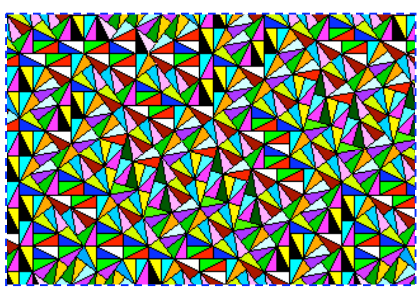

Figure 4. *Pinwheel* [18]

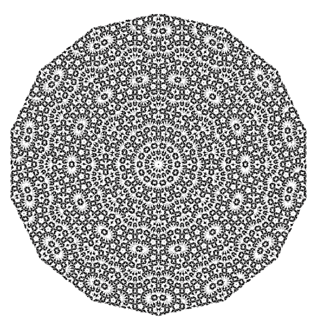

Figure 5. *Danzer* [19]

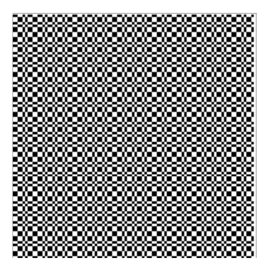

Figure 6. *Thue* [20]

The strongest geometric example is the fractal boundary of the Mandelbrot set. As Mandelbrot likes to say, "Everywhere it is new, but everywhere it also seems familiar."

For something more linguistic, we turn to Thue-type sequences [20]: *abba baab baab abba ba...* . This infinite string is produced by parallel replacement, starting from *a* and using the two rules $a \to ab$, $b \to ba$. It is cube-free (there is no subword of the form *www*), and many initial segments are palindromic, as seen here. Related sequences are square-free (or avoid tandem repeats, in the language of gene sequencing). As with Penrose tiles, there is an enforced variety in such sequences, combined with almost periodicity (see Fig. 6 for a visualization). Superficially, they share this with many tripper TTs.

3.3. Permutation, Point Mutation, and Crossover. These patterns of constructing variants from initial forms appear in genetics, change ringing [21], and computer-mediated artistic improvisation [22]. Sometimes rules are quite restrictive, sometimes freer, but they all share the action of some permutation group. Kim Binsted and collaborators have produced several programs that achieve artificially intelligent puns (JAPE for English, BOKE for Japanese) and "dozens" put-downs [23] by recombinant means. She is also interested in astrobiology and xenocommunication; her article [24] appears to take TTs to the stars (but counsels against them). Spoonerisms [25] fall under this heading, although they may have been TTs only for Rev. Spooner or those similarly afflicted. Most examples are apocryphal; according to [26], the only substantiated spoonerism is *The weight of rages will press hard upon the employer.*

4. Generation methods.

4.1. Demonstration testbed. We shall apply our generative processes below to the following special situation. We seek to construct phrases like *hippy happy poppy pat*, or the slightly more elaborate

nippy nappy funny honey and *patty pappy party path*.

Thus we use the English lexicon and whatever semantics emerges, but syntactically we are limiting the test cases to an alphabet of four consonants (h,n,p,t) with vowels±r/l, and allow the digraphs ph/f and th as alternatives. Here, we are using an informal phonetic notation, not the International Phonetic Alphabet, and allowing somewhat loose specification for search in the lexicon. We only have the patterns $(\mathrm{CVCy})^3$ CVC, or the longer $(\mathrm{CVCy})^7$ CVC. In addition, we are not going to generate the vowel patterns, but supply them by lexical search. The model task then is to describe generating grammars that give interesting cases of the above patterns, yet provably avoid giving obvious duds like *patty patty patty pat.*

4.2. Introduction to formal languages. We begin by taking the English lower-case alphabet A, then form strings over it (we call them words or sentences usually; if the latter is an actual goal, we can throw in a space and punctuation marks). Any set (finite or infinite) of these strings is called a *language*. Given a language, we seek a template, a grammar, or a formula that will characterize exactly those strings. To help with that we may add a finite number of additional letters to the alphabet; the capital letters will do.

An example of template is given by the the *regular expressions* (regexp): the letters (in bold) are regexp, and if σ, τ are regexp, then so are $(\sigma\tau)$, $(\sigma+\tau)$, and σ^* (dropping parentheses if unambiguous); the first means concatenation, the second means either σ or τ can appear, and the third means σ is to be repeated any number of times (including none!). Thus $(\mathbf{b}(\mathbf{a}+\mathbf{b})\mathbf{b})^*$ is an expression for the language consisting of repeats of b-sandwiches—bab or bbb—along with the empty string λ. In particular, the regexp $(\mathbf{bbb}+\mathbf{bab})^*$ represents the same language.

An example of a grammar is given by these four rules $\mathrm{S} \rightarrow \mathrm{ASB}|\lambda$, $\mathrm{A} \rightarrow \mathrm{a}$, $\mathrm{B} \rightarrow \mathrm{b}$ (we combine $w \rightarrow u$, $w \rightarrow v$ as $w \rightarrow u|v$). They generate the language $\{\mathrm{a}^n\mathrm{b}^n : n \geq 0\}$, and we use the formula $\mathrm{a}^n\mathrm{b}^n$ to specify the language another way. Here is how the grammar generates strings. The capital letters are nonterminals, and a rule can tell how to replace one string with another string over the expanded alphabet. Then the rules are applied in any order, starting from the single nonterminal S, till a string of terminals results.

The simplest formal languages commonly studied are the *regular languages,* those given by regexp (and there are several equivalent characterizations). The next more complex are the *context-free languages*. Each of these is generated by a grammar in which only a single nonterminal appears on the left side of each rule (the right side can be any string). The rule $\mathrm{V} \rightarrow w$ is free of context, because V can turn into w at any occurrence; here, w is a string of terminals and nonterminals. *Context-sensitive* grammars have arbitrary words on both sides of each rule, such as $u \rightarrow w$, but u cannot be longer than w.

4.3. Periodicity and regular expressions. The periodic structure of each of the examples in 3.1 is given by a regexp. For example, the repeated *bababa* ... is captured by $\mathbf{ba}(\mathbf{ba})^*\mathbf{ba}$. While the examples are reminiscent of tongue twisters, regular languages are likely to be too general and to offer structures that are not very confusing. On the testbed, we get *patty patty patty pat* as an string in $(\mathbf{pt})^*$. Not all is lost, for *pity party pithy port* is also there. But regexp are likely to include many nontwisting, boring entries.

4.4. Context-free grammars. Taking S → ABAB, A →hn|pt, B → pn|pp as a grammar, we find the language contains *honey penny putty pan*, and also *honey peppy happy pope*, one of which may appear to the reader as a slight TT. But duds like *honey pappy honey pop*, and far worse, are also there. There seems to be more control, but not enough: what happens in one word (CVCy) does not affect the next.

4.5. Context-sensitive grammars. Taking S → FLFL, F →hn|nt, hnL → hnnn, ntL → nthn, gives us a grammar with much more control. It can generate *honey nanny natty hen*, but not the weaker *honey nanny henny nun*, which could result if the contexts were dropped. But this sort of rule can change the context too. For example, replace the second L rule with ntL → nppn and so derive *honey nanny nappy pun*, which seems better than the first two. Context-sensitive rules are so flexible that it is hard to imagine a classification of them that will incline naturally toward TT production. But this does appear to be the type of formal grammar most suitable for TT language generation.

4.6. Parallel replacement. The processes above are sequential in nature and tend to produce a range of TTs, including weak ones. The Thue pattern gives parallel examples of some virtue. Thus, *abbabaab baababba* sets the pattern for *tippy patty party tappy, perty toppy teepee pot*, which is arguably a TT.

4.7. Group action. Applying the permutation (34)(67) to *happy penny patty pope* produces *happy nippy peppy tap*. Clearly, this sort of post-production transformation is likely to be fruitful, but deciding which of the vast assortment of permutations to try provides a search problem of considerable complexity. One approach is to extract permutations that work; for example, spoonerisms are transpositions, usually one, but sometimes several.

4.8. Intermodulation. All of the above methods have some scope for producing TTs, but perhaps the best conclusion is that several are required. This is made plausible by tripper examples. Part of the TT strength emerges from global properties, such as alliteration and rhyme, part from local properties such as the articulation collision between a pair of successive words, and part from patterns that link distant hotspots. These are all apparent in *The sixth sick sheikh's sixth sheep's sick.* Because no one method can easily manage this much control and variation (although context-sensitive grammars have the capacity), it is meet to meld modulating modalities by layering lower levels leavened with extracted actual practice.

4.9. Semantic generation. Because a good part of the charm of TTs is their meaningfulness in the language, we might try to generate them by starting with a semantic structure and seeking syntactic and lexical entries to realize the meaning as a TT. This idea was proposed by USF Computer Science graduate student Nicholas Ilacqua, who has a linguistics degree. His report is given in Section 6 below.

4.10. Intelligent search. As already mentioned in 3.3, Binsted has had success in applying pattern reorganization and lexical and semantic search to linguistically restricted domains of humor. This is likely to be successful (and economical) on TTs, for brute force searching is rarely the best first approach. It would mean identifying useful templates (such as the testbed in 4.1) and applying knowledge-base techniques. All of the above generation methods could benefit from her treatment.

5. Related phenomena in language and beyond

5.1. Phonologically minimal languages. Nothing suggests that TTs are more prevalent (for native speakers) when there are simply fewer sounds. Thus despite having just eight consonants, Hawaiian has only one example (so far) in [6]; at the same time there is its famous battological *word*: *aaaaa* (here without glottal stops, as recalled from *Ripley's Believe it or Not*). Rotokas (from Papua New Guinea) is an even more phonologically restricted language: five vowels (a e i o u) and six consonants (g k p r t v) with no consonant clusters, no closed syllables, no tones, no contrastive stress [27]. So to many nonspeakers, even ordinary expressions do appeal as TTs:

ouokivuia ragai ibu iare avaraepa ogoevira ikauoro
eakepa viapau rera kaakau taparevora voari.

While strings of vowels present some articulation difficulty, most readers will agree that consonant clusters are more frustrating.

Infant utterance does not belong here, because it is not language although very thin phonologically.

More pertinent are the sonic languages: Silbo Gomero and other whistle languages, drummed languages (as opposed to drum signaling), and the representation (in the reverse direction of the first two) of Indian drumming through the spoken *tabla bol*. Again, despite the narrow range of sounds, the gamut of expression is broad. It would seem that some TTs result, but others pass away into periodicity by having the phonological range flattened. A similar practice, replacing song lyrics with the names of the notes (called “solfa,” “solfeggio,” or “fasola”) does not produce TTs unless so driven by the music. Because some music is likely to have the structures mentioned above, solfa can sound very much like TT, for example, in the fast passages of Nusrat Fateh Ali Khan’s qawwali.

5.2. Restrictive wordplay: palindromes, pangrams, and formalist literature. Although these do not contribute purposely to the body of TTs, the tendency to tortured language produces some effect, such as the canonical perfect pangrams (each letter used exactly once) [28]:

Cwm, fjord-bank glyphs vext quiz; Squdgy fez, blank jimp crwth vox! (two in, yes, English)
Törkylempijä vongahdus. (Finnish, no foreign/loan letters)
Pójdźże, kiń tę chmurność w głąb flaszy! (Polish)

The inverse problem of a lipogram (leaving out letters) is pursued in Perec’s famous e-less novel *A Void* (or *La Disparition*) and in new formalist work by Christian Bök. These are often so fluid that it is not easily judged as tortured.

A bridge between the written and the read is made by the inversions or ambigrams of Scott Kim, Doug Hofstadter, and others [29]. *Onomatopoeia* (Fig. 7) is TT in both the word and the notion, and now visually as well. Fig. 8 is a tessellating example.

Figure 7. Onomatopoeia[11] *by Scott Kim* [30]

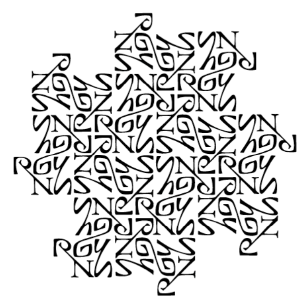

Figure 8. Synergy *by Scott Kim* [30]

5.3. Visual illusions and paradoxes. Besides the Penrose triangle and staircase instances, there are numerous artistic expressions of ambiguity, morphing, figure-ground confusion, and other mental twisters popular in the work of Magritte, Escher, Dalí, and many more [31]. The McCollough Effect produces an illusion of color from periodic bars that can be induced locally on each retina; see [32] for pointers to this and a vast world of optical illusions. Here are two periodic patterns that may appear to be animated; they are said to be useful in determining stress levels in the viewer [33].

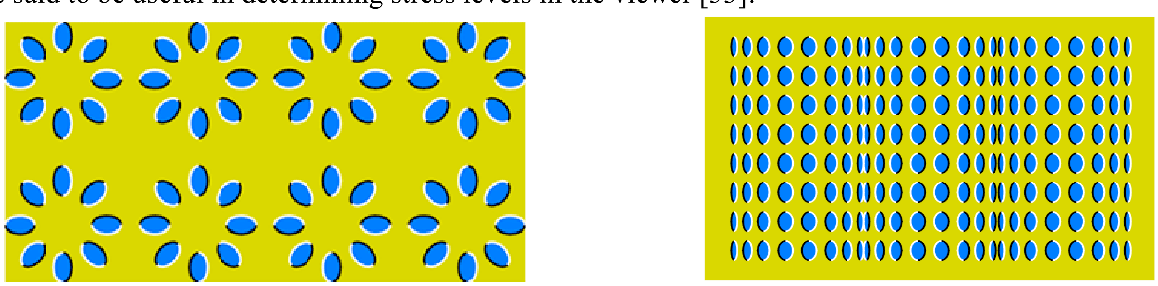

Figure 9. *Visual stress tests*

5.4. Movement. Chinese acrobats and rhythmic gymnasts have introduced us to a more fluid, more elegant whole-body analogue of TTs than Twister or more traditional contortionism could offer. The dynamism of STREB, the computer-aided choreography of Merce Cunningham, and the weight-sharing inventions of Pilobolus provide new dimensions for considering nonverbal forms of TT. American Sign Language offers TTs called "finger fumblers"; *good blood, bad blood* is said to be a TT in both English and ASL [34]. Along these lines, one may wonder whether braille affords the equivalent of a twister.

5.5. Speechreading and visemes. The many-to-one mapping of phonemes to visemes (visually distinguishable facial expressions [35]) suggests that perceptual parallels to TTs may occur here as well, and that they are likely to be more ambiguous and more numerous. While there have been some studies of whether hearing or deaf readers and native signers make more errors or slower syntactic judgments on tongue- (or other modality-) twisters [36], there is nothing easily discoverable about purposeful ambiguities targeted at speechreading, whether it be for fun or dissimulation. It would seem that speechreading a rhythmic TT could be entertaining even if not confusing.

6. Acknowledgment and report on TT generator research

Besides giving me expert tips on linguistics, which have improved this paper, Nicholas Ilacqua has spent many hours working toward a TT generator along the lines of 4.9. Aspects that he believes can form the foundation of a generator are: (A) nursery rhyme semantics, (B) nursery rhyme syntax, (C) repetition of similar sounds, and (D) nursery rhyme prosody. He has written the following summary of this work.

"The semantics (A) can be achieved through a semantics database, trained to concepts on existing nursery rhymes and fanciful children's stories. A semantic structure could be formed so that the concepts make some sense together. The syntax (B) is gained by taking the semantic structure and assigning simple syntactic structure, i.e., very few clauses. The repetition of sounds (C) is achieved through the choice of words to actualize the semantics. Using another database as a sort of thesaurus, the sounds in the sentences can be mixed and matched to form the optimal TT. The appropriate prosody (D) is harder as the rules for prosody are harder. TTs seem to have the same sort of bouncy rhythms that nursery rhymes have. The simplest way to do it seems to limit words to two syllables. That seems to rule out the bad cases, along with some good cases too. This first attempt will be done differently next time.

"I searched for linguistic theories of TTs and failed to find any. The next preoccupation was pursuing how exactly to evaluate whether a TT in step (C) has been adequately formed. In particular, what does the repetition of sounds look like? I haven't found a formula I liked. In general I've gone from a more complicated structure to a simpler one. Previous versions did fancy stuff with feature comparison, which I decided was pointless. The last best version took as a focal point the most common vowel or consonant that starts words; get a ratio of it compared to other consonants or vowels; get some other ratios on presence of onsets and codas; combine them and get a number. Here are the issues that drove the evaluator:

- Well-formed TTs do not appear to have a syntactic basis. (1) and (2) below have the same consonants placed in the same groupings, but (2) isn't a TT in my view. Instead, it appears there must be a qualified relationship between a group of sounds; presumably, then, the quality of the sound needs to be taken into account.

  (1) Great crates create great craters, but great craters create greater craters.

  (2) Late crates create late craters, but late craters create later craters.
- (3–5) show TTs must take vowels into account, which means working with the full syllable and possibly other structure. This increases the complexity, as the building blocks of TTs must be heterogeneous.

  (3) Pope's pups poop. (4) Sid said sad sods sowed. (5) Pat's pet puts pits in pots.
- As for relationships between sounds, the sounds don't need to be the same. Like great/crate in (1),

they can be similar, in sharing a sound in the initial-syllable onset. In (6), s and sh are similar:

(6) Shelly sells seashells by the sea shore

- How much phonetic structure should be taken into account? The obvious important structure is the first sound, consonant or vowel (7), of the word. To a lesser degree, it can be the initial consonant plus vowel of internal syllables (6), or in fact the whole first syllable (8).

  (7) Eight eager eagles ogled old Edgar

  (8) Mussels with mustard is Mister Mussman's main meal
- Should lines be compared to each other? Since there are single-line TTs, the answer is no.
- Should extra credit be given to long TTs? If so, this leads to point system instead of percentage system, giving long inferior TTs more points than superior short ones. I decided against taking length into account.
- Words should be similar, but not too similar. For example, a phrase made up of the same word may be a mind bender (such as buffalo^7), but it doesn't challenge the articulation, which is what tongue twisters seem to do."

Conclusion: the goal of a TT language

According to the ConLang registry [37], at the middle of April 2007 there were 1881 constructed languages, including pidgin, literary, and special purpose languages. Legend-edge cottage languages with the highest hits since the site went wiki were Quenya (Tollkien), Esperanto, Asha'ille (felinoid), Nadsat (from *A Clockwork Orange*), Gibson Aramaic, Klingon (*Star Trek*), Modern Latin (Romance auxlang), Alantean (Disney), and Lojban. Lojban is an unambiguous language supporting logic and a successor to Loglan, which shows up around position 100. Numerous constructed languages have been based on logic. Many more border on an order of frivolity. Although the work on TTs is in a preliminary stage, one may discern a ferment, a fervent omen, a fervid moment to foment a formant dormant in the domain. In other words, it is time to construct a TT-friendly, TT-prone language to register at ConLang.

References

[1] B. L. Benderly, "Don't believe everything you read … ...," *Psychology Today* **23**/11 (1989), 67–69.
[2] http://members.aol.com/gulfhigh2/words12.html, but see .../words11.html
[3] http://www.americanheritage.com/articles/magazine/ah/1955/2/1955_2_119.shtml
[4] http://en.wikipedia.org/wiki/Tongue-twister
[5] http://en.wikipedia.org/wiki/Chrzaszcz
[6] http://www.uebersetzung.at/twister/
[7] http://en.wikipedia.org/wiki/List_of_homophonous_phrases
[8] http://en.wikipedia.org/wiki/Lion-Eating_Poet_in_the_Stone_Den
[9] http://www.imdb.com/title/tt0049096/quotes
[10] http://en.wikipedia.org/wiki/St%27at%27imcets_language#Reduplication
[11] http://en.wikipedia.org/wiki/St'at'imcets_language and http://www.uni-leipzig.de/~ff/cpdp/cpdp_publications/chintang_triplication.pdf
[12] http://en.wikipedia.org/wiki/Shepard_tone and http://www.cameron.edu/~lloydd/webdoc1.html
[13] D. Deutsch, "Musical Illusions and Paradoxes," "Phantom Words and Other Curiosities"; two CDs, Philomel Records, http://www.philomel.com (1995, 2003)
[14] http://mathworld.wolfram.com/PenroseTriangle.html
[15] http://www.physics.montana.edu/demonstrations/video/6_optics/demos/impossibletriangle.html; also see http://www.stats.uwaterloo.ca/~cgsmall/penrose.html
[16] http://mathworld.wolfram.com/PenroseTiles.html

[17] http://www.mathpages.com/home/kmath539/kmath539.htm
[18] http://www.itap.physik.uni-stuttgart.de/~gaehler/tilings/pin.html
[19] http://www.maths.gla.ac.uk/~phk/aperiodic.htm
[20] http://mathworld.wolfram.com/Thue-MorseSequence.html
[21] http://www.ringing.info/
[22] Sims and Mojo; see http://www.wizardnet.com/musgrave/mutatis.html
[23] K. Binsted, B. Bergen, J. McKay, "Pun and non-pun humor in second-language learning," http://www2.hawaii.edu/~bergen/papers/binsted.pdf
[24] K. Binsted, "Tongue-tied: the disadvantages of using natural language for interstellar message composition," http://www.ifa.hawaii.edu/~meech/a734/papers/TongueTied.pdf
[25] http://www.fun-with-words.com/spoonerisms.html
[26] *Oxford Dictionary of Quotations* (3rd edition, 1979)
[27] http://www.langmaker.com/outpost/xial.htm and http://en.wikipedia.org/wiki/Rotokas_language
[28] http://en.wikipedia.org/wiki/Pangram
[29] http://www.ambigram.com/
[30] http://www.scottkim.com/inversions/index.html
[31] A. Seckel, *Masters of Deception: Escher, Dalí & the Artists of Optical Illusion*, Sterling), 2004.
[32] http://en.wikipedia.org/wiki/Visual_illusions
[33] http://www.tennismates.com/stress_test.asp
[34] http://en.wikipedia.org/wiki/Finger_fumbler
[35] http://en.wikipedia.org/wiki/Viseme
[36] C. Musselman, "How Do Children Who Can't Hear Learn to Read an Alphabetic Script?" *Journal of Deaf Studies and Deaf Education* 5 (2000), 9–31.
[37] http://www.langmaker.com/db/Langmaker:Conlangs
[38] http://courses.wcupa.edu/wanko/LIT400/Africa/hottentotinfo.htm
[39] V.A. Friedman, "A Caucasian Loanword in Romani," *Papers from the Eighth and Ninth Meetings: Gypsy Lore Society, North American Chapter*. New York: Gypsy Lore Society. 1988, 18–20.
[40] http://www.castera.net/entrelacs/entrelacs.htm
[41] *Notices Amer. Math. Soc*., February 2006, Volume 53 , Number 2

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1 It is easy to find earlier TT occurrences, say in the Vedas.

2 At least among those listed in the 1st International Collection of Tongue Twisters [6].

3 The term "Hottentot" is a Dutch invention [38], but may refer to the unusual click language of the Khoikhoi people it named, mostly derogatorily, in the 17th century. No derogation is intended in the poem, nor in its inclusion here.

4 This is the first line of Jan Brzechwa's poem *Chrząszcz*. Imposing the trochaic tetrameter makes the phrase even more difficult to pronounce. Sometimes the phrase *i strząsa krople dżdżu* is added. The last word features the duplication of a sound approximated by *dj* in English.

5 According to [39], *c'amc'ami* (eyelash) is used as a shibboleth to see whether foreigners can produce glottalized consonants.

6 For pronunciation of the last three words, consult: http://www.speakdanish.dk/html/pronunciation_intro.htm .

7 This may be a neologism in [6], for OED shows "battology," dating from 1614, and usually applied to repetitious prayer/mantra.

8 With hints: Buffalo buffalo, Buffalo buffalo buffalo, buffalo Buffalo buffalo. See [7] for the history, meaning, and parsing, and similar homophonic excesses.

9 It is interesting that in spiritual traditions, the repetition is said to be crucial for breaking the bonds of the rigidified mind. Examples are the mantra in Hinduism, dhikr in Sufism, and the Jesus prayer in Hesychast tradition. It is the same dissolution offered by the koan in Zen. Is there a tradition that has used TTs for this purpose?

10 Jean-Marc Castera has analyzed the nonperiodicity used to achieve effective symmetry in some areas of the ceiling [40]. Also see the cover of [41].

11 *Onomatopoeia* was improvised. In [30] Kim says, "Other long words I have improvised as inversions during talks include *humuhumunukunukuapuaa* (the state fish of Hawaii)." That should, in one word, qualify as the next entry for Hawaiian in [6]; imagine spelling it upside-down and backwards.